

# RECENT SPECTROSCOPIC FINDINGS CONCERNING CLAY/WATER INTERACTIONS AT LOW HUMIDITY: POSSIBLE APPLICATIONS TO MODELS OF MARTIAN SURFACE REACTIVITY

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The Viking expedition to Mars provided an invaluable, but still little appreciated lesson for die-hard Vitalists among the scientific community and public at large. Not every chemical sequence of cosmochemical evolutionary significance is mediated by "living cells," even those with cosmochemical ramifications for the generation and maintenance of complex life forms. Egotists that we all are, life forms are interesting to us in how they produce their chemistry and in what they can achieve using it. However, cells are by no means unique in the chemistry that they can produce. Viking performed four chemical tests for cellular life forms; Mars passed all but the requirement for significant quantities of organic carbon. Mineral surfaces proved capable of most, if not all, of the chemistry formerly tagged as diagnostic of cellular life. Whereas we now reluctantly acknowledge the chemical facility of mineral systems, we still understand it only primitively. Nor do we even know the surface mineralogy of our closest planetary neighbors. Mineralogists and space scientists, while cognizant of the centrality of planetary mineralogy in planetary formation and evolution, have yet to fully credit the actuality that, among mineral types consistent with the Viking elemental analysis, some are more interesting than others on the basis of their capacity to drive surface chemistry of types producing precursors and constituents of cellular life. Among those minerals "more equal" to Exobiologists are the phyllosilicates, carbonates and phosphates that are postulated or known to be catalysts of biologically interesting organic chemistry, or to be relics of cellular life forms. Analysis of Viking elemental data and surface chemical simulations allow consideration of variably iron cation-exchanged montmorillonites as plausible MarSAMs. Analysis of Martian surface reflectance data are more inclusive than, even at odds with this simple model. However, quantitatively estimated mineralogy using reflectance data is a risky business in the light of our abysmally developed repository of ground based truth regarding structurally defective, non-stoichiometric materials and mineral mixtures in the less than  $2\mu$  particle size range.

We have extended a feasibility study assessing the utility of our adaptation of near infrared correlation spectroscopy to quantifying iron and adsorbed water in some clay-based MarSAMs. The work was intended to constitute Phase I of a novel approach to identifying optical analytical wavelength regions, not only for important mineral classes, but for chemically active centers within them. Many of these centers are common to unrelated mineral classes and of disproportionate influence relative to the mineral structure as a whole in determining the surface reactivity of mineral surfaces. We previously reported linearity between reflectance and total iron and total moisture over a large range of both key variables. We also discovered interesting relationships between the intensity of iron bands and the relative humidity of the systems. These relationships now have been confirmed. We show also that, in the low humidity range, reflectance is linearly dependent on a different kind of water from that best representing the full humidity range (the kind of water associated, in clays, with surface acidity). These relationships and the sensitivity and capability of quantitation of NIR data indicate high promise of the method for being able to predictively correlate mineral spectroscopy with the production of reactive surface intermediates or products of surface reactions.